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Wind Cave National Park Resource Management News Briefs

This Issue Edited by Rodney D. Horrocks, Physical Science Specialist

Caption: *Ken Geu, Duff McCafferty, & Rod Horrocks in the Muddle Room in the Historic Section of Wind Cave. Multi-flash NPS photograph by Dan Austin. This 18mm photo was taken with a Nikon D200 digital camera.*

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Audible Earthquakes Heard in Wind Cave

By Rodney D. Horrocks, 10/3/08
WICA Physical Science Specialist

Although, the southern Black Hills are prone to earthquakes, most register under 3.0 on the Richter Magnitude Scale* and do not cause any damage on the surface or in Wind Cave. The only apparent exceptions in the cave were a single rock that toppled onto the paved trail in1907 and a small roof collapse in 1964, both attributed to earthquakes. The March 24 and 27, 1964 events were attributed to either a small earthquake near Van Tassell Wyoming or the great Alaska earthquake at Prince William Sound.

A rock that rolled onto the paved trail in Wind Cave in 1907 that was attributed to an earthquake (NPS photo).

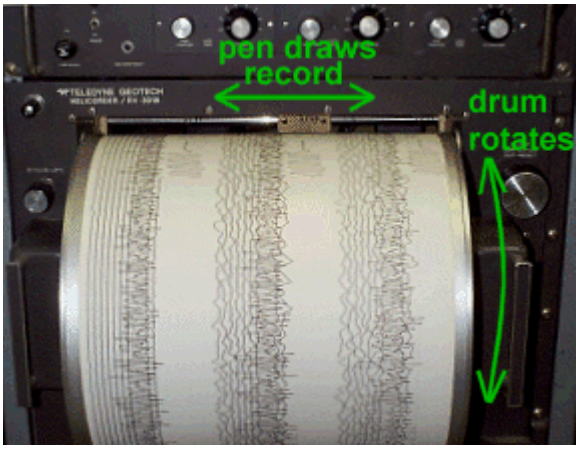
There is a long history of earthquakes in the southern Black Hills. The first documented earthquakes in the Wind Cave area occurred in 1892 and they have continued sporadically ever since. A swarm of seven earthquakes, most of which originated just north of Edgemont, SD, were documented between 1999 and 2000. A number of park employees experienced these events, noting their location, exact time of occurrence, and their duration. These documented events most likely represent a fraction of the total number that occurred at this time. Most of the documented events lasted from 3-5 seconds. In some cases, when those employees reached the surface, they were asked by people in the visitor center if they had felt the earthquake, but they had not. Interestingly, only a couple of these events were actually correlated with earthquakes picked up by nearby station seismographs (these stations are located at the South Dakota School of Mines & Technology in Rapid City, Golden Colorado, Lewis & Clark Caverns Montana, and Idaho Springs).

Our experience during the last decade is that most earthquakes are heard and not felt in Wind Cave. The study of audible earthquakes is called Auditory Seismology. Almost nothing has been done with Auditory Seismology in relation to caves. An upcoming research project in Wind Cave by Margaret Bruchez hopes to capture one of these earthquakes with a sensitive sound recording device.

In Wind Cave, if a cave visitor happens to be standing or sitting quietly when an earthquake occurs, they will hear a low rumbling sound above or below them or they will hear a rolling thunder-like sound coming down the cave passage towards them. These rumbles are so low, they are not heard if a group happens to be moving or talking during the event. The rumbling sound in the cave is likely created as the fast moving P waves (compressional or longitudinal body waves) that radiate from the earthquakes epicenter and quickly encounter the cave. When these waves first intersect the cave, they generate a one dimensional acoustic wave in the air-filled cave within a fraction of a second of their arrival. As these waves oscillate the cave walls, the changes in pressure create acoustic waves at 30 Hz (30 oscillations per second), which the cave visitors hear as rolling thunder-like sounds. The reason that only low rumbling sounds are heard may be because the higher frequencies are filtered out the farther one is from the epicenter of the earthquake. If the frequency of an earthquake was below 20Hz, it would not even be audible to the human ear. However, those are exactly the frequencies used by seismographs to document earthquakes on station seismographs.

The S waves (shear waves) follow the P waves and only travel through solid rock, not liquids or

air. These waves produce the shaking commonly felt during earthquakes. Since shaking is not felt in caves during an earthquake, it is theorized that the S waves pass around the cave and hit the surface, where the shaking is felt. Fairly often earthquakes are heard in Wind Cave that were not detected at any of the nearby station seismographs. Because nearby seismic stations are located so far from Wind Cave, they typically do not register any events under 3.5 on the Richter Magnitude Scale*. Nearby Jewel Cave has documented many similar audible earthquake events. At both Wind and Jewel Caves, rooms in the caves have been named after cave surveyors heard an earthquake, generating such names as Seismic Hall and Rumble Loft.



* The Richter magnitude Scale is a base-10 logarithmic scale, with 1 being a low amount of seismic energy and 10 a high amount. With each whole number increase, the shaking amplitude is increased by 10 times or the energy released is increased by 31.6 times.

What Does Climate Change Mean to Wind Cave National Park Vegetation?

By Beth Burkhart, 9/3/08
WICA Botanist

People come to the park to experience "nature" in an area managed for natural and cultural resource preservation. While the backdrop – prairie/savannah vegetation – may seem to be static, ecological systems including plant species/communities are very dynamic. It is a challenge to understand the dynamics of vegetation since movements of plant species across the landscape occur much more slowly and subtly than those of animal species. To get in the proper frame of mind, think about following a radio-collared plant seed (for example, a floating milkweed seed) rather than a radio-collared elk! Similarly to animal species, plant species adjust their distributions to colonize locations meeting their growth requirements (for example, new habitats/niches such as those created by disturbances like fire and flood) or generally continue to disperse into suitable habitat distant from their location of origin as a species.

Wind Cave National Park – Vegetation as a backdrop (native mixed-grass plant communities). NPS Photo by Jim Pisarowicz.

While plant species have been adapting and moving around the landscape as long as vegetation has been on the planet, changes we are currently experiencing in climate are markedly different than anything recorded by humans. While climate change is clearly documented, the effects, including effects to plant species and communities, are not clearly known. In March 2008, Saunders and others of the Rocky Mountain Climate Organization and the Natural Resources Defense Council published a report on the West's changing climate. The report concluded that warming is common throughout the West and the West is warming faster than the world as a whole. Between 2003 and 2007, eleven western states averaged 1.7^{o}F warmer than the 20th century average, a 70% greater warming than the global average. The Intergovernmental Panel on Climate Change (Field et al. 2007) has identified the

interior western United States as one of three areas predicted to experience future heat waves that are more frequent, more intense, and last longer.

What does this mean for the vegetation of Wind Cave National Park, the Black Hills, and surrounding Great Plains? We have already seen some direct effects, like mountain pine beetle impacts to ponderosa pine forests. In the Black Hills, beetle infestations have accelerated due to the absence of cold winter temperatures. Many acres have been infected or killed and these forests are now highly susceptible to fire. In conjunction with the high fuel loads resulting from many years of fire suppression in Black Hills forests, wildfires of an intensity not previously experienced are likely. These kinds of extreme wildfires are a threat to some of the interesting plant species and communities associated with forested areas of the Black Hills.

Native plant species that provide diversity to mixed-grass prairie plant communities include shell-leaf penstemon (Penstemon grandiflorus). NPS photo by Jim Pisarowicz.

Grassland vegetation is also likely to be impacted by climate change. For example, at the High Plains Grassland Research Station in Cheyenne, Wyoming, a study by USDA Agricultural Research Station and the University of Wyoming is looking at effects of increased carbon dioxide (CO_2) and/or increased temperatures on the structure and function of northern mixed grass prairie. A preliminary finding is that increased CO_2 favors Eurasian introduced species which compete with native species for resources like water and nutrients. Increased temperatures alone did not have this result, but the combined treatment of increased temperature and increased CO_2 did.

A study by Morgan et al. (2007) showed that increased levels of CO_2 favored fringed sagebrush (*Artemisia frigida*) in a Colorado short-grass prairie. The authors suggest that an increase in shrub cover in many world grasslands over the last 200 years may have been accelerated by the increase in CO_2 following increases in man-made CO_2 emissions.

Native plant species that provide diversity to mixed-grass prairie plant communities include Virginia groundcherry (Physalis virginiana). NPS photo by Jim Pisarowicz.

As temperatures rise, plant species at lower elevations will move into newly-created suitable habitat at higher elevations, just as has been documented for animal species. Opportunities for upward migration of plant communities can provide resilience. However, plant species at the top are limited in where they can go. Wind Cave National Park vegetation is not at high elevation with respect to the Black Hills, but is at high

elevation relative to the surrounding Great Plains. As species/communities migrate out of the park, it is expected that new species/communities would move in. However, details about what park vegetation will look like in the future are unknown.

Wildflowers may also be affected by climate change. David Inouye (2008) published a study that documented increasingly early spring snow melts that triggered an early growing season and higher frequency of frosts. The early growing season stimulated an early flowering response that resulted in new buds being killed by frost. The study documented that three long-lived perennial plant species in Rocky Mountain National Park had drastic reductions in seed production. This is a subtle change that might only become measurable in decreased population levels decades into the future.

Native plant species that provide diversity to mixed-grass prairie plant communities include bracted spiderwort (Tradescantia bracteata). NPS photo by Jim Pisarowicz.

It is not possible to say what changes have been occurring to Wind Cave National Park vegetation recently. However, an example of the magnitude of change possible in just 100 years has recently been published by researchers at Boston University and Harvard (Willis et al. 2008). They used notes made by Henry David Thoreau on more than 500 species between 1851 and 1862 and other sources to conclude that common species are flowering 7 days earlier than they did in Thoreau's day, that 27% of species documented by Thoreau have disappeared from Concord, Massachusetts and that 36% are present in such small numbers that they will probably not survive for long. Those findings are surprising enough. In addition, evolutionary biologists who contributed to the study found that the decrease is affecting certain groups of plants and not others, particularly affecting some of the most charismatic species – orchids, mints, gentians, lilies, and iris. One conclusion is that the extent to which flowering-time response to temperature is shared among closely-related species might have important consequences for patterns of species loss under rapid climate change.

There is much to be concerned about as we move down the road of climate change and adapting vegetation, because we are not just observers but will interact with the results (from plants in our landscape to plants we eat). However, this is an exciting time for scientists/botanists to document changes and make hypotheses about vegetation and vegetation changes - in Wind Cave National Park as well as in all national parks and public conservation areas. Perhaps one of the most important things that can be done to support native vegetation in this era of environmental change is to give native plant species and communities the maximum "space" possible to adjust, geographically as well as by creating buffers from man-induced stresses that can be controlled, such as competition with non-native invasive species, excessive utilization by herbivores, and the occurrence of fire. The first step in that direction may simply be to remember that the native vegetation "backdrop" to Wind Cave National Park is not static but an actively evolving natural resource as important as soil, water, wildlife, caves, and other valued natural resources to the mission of preserving the integrity of Wind Cave National Park ecosystems for future generations.

Stay tuned for more articles on Wind Cave National Park plant species and communities in future Resource Ramblings. The spring 2009 issue will feature vegetation as the main topic.

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Dusting Efforts During 2008

By Dan Roddy, 11/3/08
WICA Biologist

Over 2 months and 60,000 burrows, the park resource staff completed its dusting efforts for the summer/fall 2008.

In an effort to protect the black-tailed prairie dog (a keystone species) and the "endangered" black-footed ferret, park resource management staff began their "dusting" efforts on August 20 and ended on October 28, 2008. The insecticide, Deltamethrin (DeltaDust), was applied to over 60,000 prairie dog burrows and other holes (active and inactive) within the Bison Flats and Norbeck prairie dogtowns. This was a major time and resource commitment but a necessary management action to be proactive and try to prevent our wildlife from being infected with plague and to avoid any health risk to humans. The DeltaDust is applied into prairie dog burrows or other holes where rodents may be found through a specialized piece of equipment known as a "Techni-duster". The motor in the duster forces the dust through the end of a wand that is placed down into the prairie dog burrow (see below) where the fleas and rodents live. The dust is meant to kill the fleas, which are the carriers of the plague. Plague has never been documented within Wind Cave National Park or the adjacent area but it has recently been found within 15-25 miles from the Park.

Many thanks to all that helped in making this effort possible e.g. Northern Great Plains Fire Office, WICA Fire Program, WICA Resource Protection, WICA Maintenance, Devils Tower NM, Mt. Rushmore NM, WASO Office in Fort Collins, US Fish and Wildlife Services, USGS and the Black Hills NF.

Biological Science Technician Kevin Miller applying DeltaDust to a prairie dog burrow.

2008 Christmas Bird Count

By Dan Roddy, 11/3/08
WICA Biologist

The 14th annual Wind Cave National Park Christmas Bird Count will be held on Sunday, December 14th, 2008. It is patterned after the nationwide National Audubon Society effort to document trends in wintering birdlife throughout

the United States. The area we'll cover is a 15 mile diameter circle with the center of the circle being the Rankin Ridge fire tower. The count covers all of Wind Cave NP and areas of the Black Hills National Forest and Custer State Park. We plan to meet at the Park Visitor Center around 8am, and after a great day of birding we'll meet for a Pot Luck Supper around 4:15pm, at the VIP center. Send a note if you think you can make it...or just show up. Please call Dan Roddy at 605-745-1157 or Barb Muenchau at 605-745-1150 if you have any questions.